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Docket No. 55506(70840)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: Nobuyuki Itoh, et al.

U.S.S.N.: 09/745,074

Art Unit: 2871

FILED: December 20, 2001

Examiner: Timothy L. Rude

FOR: LIQUID CRYSTAL DISPLAY APPARATUS

Mail Stop: Non-Fee Amendment

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

RESPONSE TO OFFICE ACTION

Sir:

Applicants are in receipt of the Office Action dated April 9, 2003 and request reconsideration of the above-identified application in view of the following remarks.

REMARKS

The Applicants appreciate the Examiner's thorough examination of the subject application. Applicants request reconsideration of the subject application based on the following remarks.

Claims 1, 2, 4-14 are under examination and claim 3 has been withdrawn pursuant to the election made in the response of January 10, 2003.

A brief description of the present invention may be of assistance in addressing the rejections set forth by the Examiner under §103.

Claim 1 of the present invention provides a liquid crystal display apparatus wherein a side of each of the pair of substrates facing the liquid crystal layer is subjected to a vertical alignment

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treatment; and the liquid crystal molecules are tilted in a uniform direction from at least one side edge of the at least one electrode to an opposite edge where a voltage is applied to the at least one electrode. The liquid crystal display apparatus of the invention offers greater contrast and higher response speed in comparison with conventional apparatuses. None of the cited references, taken alone or in combination, disclose nor suggest, the technical features provided by the present invention.

More particularly, the present invention is directed to a liquid crystal display apparatus which operates on the vertical alignment (VA) mode in which the liquid crystal molecules are vertically aligned in the absence of applied voltage, and horizontally aligned, i.e., tilted, in the presence of applied voltage. Display apparatus which function based on vertical alignment (VA) of liquid crystalline molecules are significantly different from display apparatus which function based on twisted nematic (TN) mode in which the twist of liquid crystal molecules is altered in response to applied voltage. Moreover, application of a voltage to a TN mode apparatus typically induces rotation or twisting of the liquid crystalline molecules without changing the tilt of the molecules relative to the surface. Thus, the vertical orientation of the liquid crystalline molecules in a TN mode liquid crystal display apparatus is not essential to the cell or pixel operation.

The present invention, particularly the invention claimed in independent claims 1, 4, and 7, provides liquid crystal display apparatus which operate based on vertical alignment and deflection or tilting of the liquid crystalline molecules upon application of a voltage potential. More particularly, claims 1 and 4 provide substrates which are subjected to a vertical alignment treatment (i.e. the liquid crystal molecules are naturally in a vertical orientation), and tilt in a uniform direction (i.e. towards the horizontal) when a voltage is applied to the cell.

The present invention further provides, in claim 7, liquid crystal display apparatus in which those liquid crystalline molecules which are in non-pixel regions of the apparatus are in a uniaxial (i.e. not twisted) horizontal alignment. Such an alignment facilitates vertical-horizontal transition of liquid crystalline molecules present in the pixel region of the display apparatus.

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None of the references cited in the Office Action, taken alone or in combination, disclose or suggest the liquid crystalline display apparatus provided by the present invention.

Claims 1, 2, and 4-6 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Hirata et al (U.S. Patent 5,872,611) in view of Colgan (U.S. Patent 6,256,080).

The rejection is respectfully traversed.

As the reference is understood, Hirata teaches a liquid crystal display apparatus which operates based on a twisted neumatic mode, e.g., application of voltage to the apparatus twists the liquid crystalline molecules of the apparatus but does not cause the molecules to tilt. Moreover, Hirata teaches the application of an oblique electric field across the TN cell in order to increase the viewing angle of the TN Cell. That is, an electric field is applied to the TN cell through gaps in the electrodes or gaps in the insulating layers in order to improve the viewing angle of the TN cell. Thus, Hirata neither discloses nor suggests any VA mode cells or any liquid crystal display apparatus which operates using a VA mode.

The Office Action alleges that one skilled in the art would modify the TN cell recited by Hirata with components disclosed by Colgan for use in the VA cells recited therein. Applicants respectfully disagree. The combination is simply not proper, in part because TN and VA cells function using completely different physical phenomena of liquid crystalline molecules in an applied electric field.

Liquid crystal display apparatus which rely on vertical alignment (VA) of the liquid crystalline molecules operate based on a completely different and non-analogous physical property compared to display apparatus based on a twisted nematic mode of operation. Thus, one skilled in the art would not be motivated to combine apparatus based on VA and TN technology.

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Hirata teaches an apparatus in which the liquid crystalline molecules rotate upon application of an applied electric field. That is, the vertical alignment of the liquid crystalline molecules in the Hirata apparatus is not affected by application of an electric field.

In contrast, Colgan teaches a VA cell in which the liquid crystalline molecules are tilted from vertical alignment by application of an electric field. See, for example, figure 3 of Colgan. No apparent benefit could reasonably be predicted by treating a TN cell with a vertical alignment process, in part because the operation of the TN cells functions based on twist or rotation of the liquid crystalline molecules and does not function based on the tilt of the molecules relative to the substrate.

One skilled in the art would not have expected any benefit in a TN cell from vertically aligning the liquid crystalline molecules in the TN cell and tilting said molecules by application of an electric field.

For at least the reasons discussed above, claims 1 and 4 are patentable over any proper combination of Hirata and Colgan. Claims 2, 5, and 6 depend from claims 1 and 4 and are therefore also patentable over any proper combination of Hirata and Colgan.

Claims 7-14 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Hirata et al (U.S. Patent 5,872,611) in view of Colgan (U.S. Patent 6,256,080) as applied to claims 1, 2, and 4-6 above, and further in view of Numano (U.S. Patent 6,313,898).

Claim 7 is patentable over any proper combination of Hirata and Colgan for at least the reasons discussed in response to the rejection of claims 1, 2, and 4-6. The Numano document fails to overcome the limitations of any proper combination of Hirata and Colgan. That is, the Numano reference fails to teach or suggest vertically aligning the liquid crystal layer and then tilting the liquid crystal molecules in a uniform direction by application of a voltage.

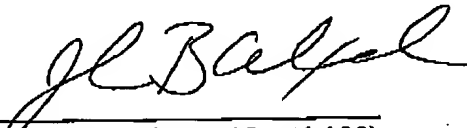
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Claim 7 is patentable over any proper combination of Hirata, Colgan and Numano.
Claims 8-14 depend from claim 7 and are therefore also patentable over any proper combination of Hirata, Colgan and Numano.

Although it is not believed that any additional fees are needed to consider this submission, the Examiner is hereby authorized to charge our deposit account no. 04-1105 should any fee be deemed necessary.

Respectfully submitted,

Date: July 9, 2003


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